The development of new solar observing modes of ALMA

*Masumi Shimojo[1], The international development team of ALMA solar observations

1. National Astronomical Observatory of Japan

The solar observations with ALMA have been offered by ALMA observatory since the open-use period in 2016-2017 (Cycle 4), and the scientific solar observing was started in December 2016. The Sun is the nearest star and its radio emission received at the earth is incomparably stronger than that from the celestial objects like star-forming regions and high-z galaxies. Hence, the various measures are needed to observe the Sun with ALMA that was constructed for observing such celestial objects (Shimojo et al. 2017, White et al. 2017). Due to the measures, the observing modes for solar observations that were offered for Cycle 4 is limited as follows; The observing frequencies are fixed at 100 GHz (Band3) or 239 GHz (Band6), only the compact antenna configurations are available, and the mode of the correlator is continuum mode only. The solar observing modes are used for not only Cycle 4 but also Cycle 5 (2017-2018) and Cycle 6 (2018-2019).

To utilize most observing functions of ALMA for solar observing, the international development team of ALMA solar observations works on the development of new solar observing mode. However, the machine time for commissioning is decreasing because the development of most observing modes had been finished and ALMA project shifted normal operating state. To develop solar observing modes effectively in such situation, we prioritized the observing modes based on the demands from the solar community. The current priority is following; 1) Higher observing frequencies (Band7 and Band9) that show temperature minimum and might realize higher spatial resolution, 2) Full-Stokes polarimetry to obtain the signal of the magnetic fields in the chromosphere (Band3), and 3) High-cadence scans of a small field of view with a single-dish observation. We are considering other modes, for instance, the flexibility of observing frequencies, and sub-seconds cadence. In the paper, we summarize the candidates of new solar-observing modes, and report the status of the development.

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